

# ***U.S. PATENT APPLICATION***

*Inventor(s):*      Carl DIONNE  
                          Martin LAVOIE

*Invention:*      DUPLICATION SPACE

*NIXON & VANDERHYE P.C.  
ATTORNEYS AT LAW  
1100 NORTH GLEBE ROAD  
8<sup>TH</sup> FLOOR  
ARLINGTON, VIRGINIA 22201-4714  
(703) 816-4000  
Facsimile (703) 816-4100*

## ***SPECIFICATION***

## Duplication Space

### Background of the Invention

#### 1. Field of the Invention

5 [0001] The present invention relates to a method of sharing data over a network, having a plurality of network connected terminals, each comprising memory means and processing means, said memory means including instructions for equipping objects with attributes and managing the duplication thereof.

10 2. Description of the Related Art

[0002] Methods according to which users share data as information or content between their respective terminals being connected to a network are widely known. The Internet is one such network, wherein user terminals access information stored on web pages in a variety of formats and can also download program files or data files by means of protocols such as file transfer protocol.

20 [0003] However, the users of such user terminals must first locate said information or data amongst the literally millions of web pages which can today be accessed on the Internet. Most of the time said location of information or data is achieved by means of generic search engines, such as Altavista or Lycos, which receive an input string ie keywords, from a user terminal, and match said input string with an identical string stored within a web page. As said matching operation is performed according to character-based Boolean parameters, said generic search engines invariably return

thousands and, potentially, hundreds of thousands of hypertext links pointing to mostly redundant matching web pages.

5 [0004] Methods are known which have improved the matching accuracy of said generic internet search engines, for instance with the inclusion of logical characters such as a "plus" or "comma" sign within the input string inputted at the user terminal. In practice, however, said methods according to the known art still fail to reduce the amount of redundant search results down to a reasonable number of entries for a user to consult.

10 [0005] A recent development in Internet connectivity is the development of peer-to-peer networking, wherein users of user terminals connected to the Internet can access information and data stored in their respective user terminals rather than stored in central internet servers. Whereas this development is known to improve problems of bandwidth utilisation and latency which are well known to those skilled in the art, said developments feature the same disadvantages in terms of locating information or data locating as explained above.

20 **Brief Summary of the Invention**

[0006] According to a first aspect of the present invention, there is provided an apparatus for sharing data over a network, having a plurality of network-connected terminals, each comprising visual display means, processing means, storage means and memory means; wherein said memory means is configured to store program instructions for equipping objects stored therein with attributes and for managing the duplication of said objects. Said processing means is configurable by said program instructions

to perform the steps of equipping an object with attributes at a first of said network terminals; at a second of said network terminals, matching said object attributes of said first terminal with the attributes of an object amongst all of the objects stored in said second terminal; duplicating said object from 5 said second terminal to said first terminal; at said first terminal, accessing data in said duplicated object using locally executed object instructions; and maintaining data consistency between said duplicated objects.

[0007] According to a second aspect of the present invention, there is 10 provided a method of sharing data over a network, having a plurality of network-connected terminals, each comprising memory means and processing means, said memory means including instructions for equipping objects stored therein with attributes and managing the duplication of said objects, including steps of equipping an object with attributes at a first of said 15 network terminals; at a second of said network terminals, matching said object attributes of said first terminal with the attributes of an object amongst all of the objects stored in said second terminal; duplicating said object from said second terminal to said first terminal; at said first terminal, accessing data in said duplicated object using locally executed object instructions; and 20 maintaining data consistency between said duplicated objects.

#### **Brief Description of the Several Views of the Drawings**

[0008] *Figure 1* illustrates a network environment, including user terminals, a cellular phone and a personal digital assistant sharing data over 25 said network environment;

[0009] *Figure 2* shows a user terminal, a cellular phone and a personal digital assistant for sharing data;

[0010] *Figure 3 illustrates the hardware architecture of user terminal shown in Figure 2;*

[0011] *Figure 4 illustrates the hardware architecture of a cellular phone or personal digital assistant shown in Figure 2;*

5 [0012] *Figure 5 details the contents of the memory of any one of the user terminals shown in Figures 3 and 4, including duplication instructions, duplicated objects and local objects;*

[0013] *Figure 6 summarises actions performed at a user terminal in order to equip local objects shown at Figure 5 with attributes and sharing data according to the invention;*

[0014] *Figure 7 shows machine readable instructions shown at Figures 5 and 6 in order for a duplication space to be instantiated;*

[0015] *Figure 8 provides a graphical presentation of the subdivision of the duplication space shown in Figure 7 into cells;*

15 [0016] *Figure 9 shows the resources required from each user terminal shown in Figure 1 in order to obtain an attributes match;*

[0017] *Figure 10 provides a graphical presentation of the respective main memories of the user terminal shown in Figures 1, 3 and 4 upon logging onto the network shown at Figure 1;*

20 [0018] *Figure 11 summarises actions performed at a user terminal in order to perform the attributes matching function shown in Figure 6;*

[0019] *Figure 12 provides a graphical presentation of the memories shown in Figure 10 subsequently to the actions shown at Figure 11;*

25 [0020] *Figure 13 summarises actions performed at a user terminal in order to perform an object duplication operation shown in Figure 6;*

[0021] *Figure 14 provides a graphic presentation of the main memories shown in Figure 12 subsequently to the actions shown in Figure 13;*

[0022] *Figure 15 summarises actions performed at a user terminal in order to perform the duplicated object update operation shown in Figure 6;*

[0023] *Figure 16 provides a graphical presentation of the main memories shown in Figure 14 subsequently to the operations shown at Figure 15; and*

[0024] *Figure 17 provides a graphical presentation of the main memories shown in Figure 16 subsequently to a publishing terminal going off line and a new terminal logging onto the network shown at Figure 1.*

10 **Best Mode for Carrying Out the Invention**

[0025] The invention will now be described by way of example only with reference to the previously identified drawings.

15 [0026] Data sharing applications distribute data amongst multiple users using a network of connected computers. An environment for connecting multiple users to whom data will be distributed is illustrated in *Figure 1*.

20 [0027] User terminal 101 is connected to the Internet 102 via internet service provider (ISP) 103 and user terminal 104 is also connected to the Internet 102 via internet service provider (ISP) 105. Internet-enabled cellular phone 106 is connected wirelessly to the Internet 102 via Wireless Application Protocol provided by internet service provider (ISP) 107 and Internet-enabled mobile device 108, which is a Palmtop PC, is connected wirelessly to the Internet via internet service provider (ISP) 108.

25 [0028] Each of said ISPs provide each individual user with a unique network address, e-mail account and other optional internet facilities such as

are commonly provided to a user with an ISP account. Thus, there is provided the scope for any which one of the above user terminals to access data stored on any which one of the other networked terminals.

5 [0029] In a preferred embodiment of the present invention, the user terminals sharing data such as shown in *Figure 1* can include many types of devices equipped with processing and displaying means, the respective configurations of which can vary to a fairly large extent.

10 [0030] Personal computer 101, cellular phone 106 and palmtop personal computer 108 are shown in greater detail in *Figure 2*.

15 [0031] Programmable computer 201 is shown equipped with a drive 202 able to receive and read from- or write to an external medium. Said external media consist of a 3.5 inch floppy disk, a CD-ROM or a re-writable CD-RAM and are well known to those skilled in the art. Thus, computer 201 may receive data, such as program instructions, via an appropriate medium by means of drive 202. Data may also be received and transmitted over a network, such as the Internet 102, by means of a network connection 203. 20 Output data is displayed on a visual display unit 204 and manual input is received via a keyboard 205 and a mouse 206.

25 [0032] Cellular phone 211 is shown equipped with an antenna 212 through which incoming and outgoing wireless signals are transmitted. Traditionally, cellular phones receive and send data in the form of voice signals by means of their antennae. However, cellular phones equipped with WAP functionality can also receive and transmit data in the form of computer-

readable instructions over a network, such as the Internet **102**, and thus  
cellular phone **211** can receive and send data by means of its antennae **212**.  
According to the known art, cellular phone **211** is equipped with a processing  
capability and memory means. Output data is displayed on a visual display  
unit **213** and manual input is received via a keypad **214**.

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[0033] Palmtop Personal Computer **221** is also shown equipped with an  
antenna **222** through which incoming and outgoing wireless signals are  
transmitted. However, Palmtop PC **221** is not dependent upon WAP  
functionality and is able to process computer-readable instructions written in  
Hypertext Mark-up Language (HTML) in an identical fashion to Personal  
Computer **201**. According to the known art, Palmtop PC **221** is equipped with  
a processing capability and memory means. Output data is displayed on a  
tactile visual display unit **223** and manual input is received via a number of  
function-specific keys **224** and a stylus **225**, which activates instructions  
displayed on display **223** by means of its tactility.

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[0034] Hardware forming the main part of computer system **201** are  
detailed in *Figure 3*.

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[0035] The system includes a Pentium III™ central processing unit  
(CPU) **301** which fetches and executes instructions and manipulates data.  
Frequently-accessed instructions and data are stored in a high speed cache  
memory **302**. The central processing unit **301** is connected to a system bus  
**303**. This provides connectivity with a larger main memory **304**, which  
requires significantly more time to access than the cache **302**. The main  
memory **304** contains between one hundred and twenty-eight and two

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hundred and fifty-six megabytes of dynamic random access memory. A hard disc drive (HDD) 305 provides non-volatile bulk storage of instructions and data. A graphics card 306 receives graphics data from the CPU 301, along with graphics instructions. Similarly, a sound card 307 receives sound data from the CPU 301, along with sound processing instructions. A CD-ROM reader 308 receives processing instructions and data from an external CD-ROM medium. A serial bus interface 309 provides connectivity to peripherals such as a mouse 206 and keyboard 205. A modem 310 provides connectivity to the Internet 102 via a telephone connection to the user's ISP 103. The equipment shown in *Figure 3* constitutes a personal computer of fairly standard type, such as a PC or Mac, whether used as a network terminal or as a network server.

10 [0036] Hardware forming the main part of cellular phone 211 or Palmtop  
15 PC 221 are detailed in *Figure 4*.

20 [0037] The system includes a central processing unit (CPU) 401 which  
fetches and executes instructions and manipulates data. Depending upon the  
manufacturer of the device, said CPU may or may not be equipped with a  
high speed cache memory 402 which stores frequently-accessed instructions  
and data. The central processing unit 401 is connected to a system bus 403,  
and said bus 403 provides connectivity with a larger main memory 404, which  
requires significantly more time to access than the cache 402 if present.  
Depending upon the manufacturer of the device, the main memory 404  
25 contains between one and eight megabytes of dynamic random access  
memory, a portion of which is configured as non-volatile bulk storage of  
instructions and data. A graphics adapter 405 receives graphics data from

- the CPU **401**. A serial input/output interface **406** provides connectivity to peripherals such as keypad **214**, keys **224** and tactile components of display **223**. A modem **407** provides connectivity to the Internet **102** via a wireless telephone connection to the user's ISP **107** or **109**. The equipment shown in  
5 *Figure 4* constitutes a mobile computing device of fairly standard architecture, the type of which however can vary to a large extent, such as a cellular phone, a Palmtop PC, a Personal Digital Assistant etc. traditionally used as a mobile network terminal.
- 10 [0038] The contents of the memory **304** or **404** of the user terminals **101**, **104**, **106** and **108** shown in *Figures 1 to 4* are summarised in *Figure 5*.
- [0039] An operating system, including a basic BIOS is shown at **501**. This provides common functionality shared between all applications operating  
15 on the user terminals **101**, **104**, **106** and **108**, such as disk drive access for terminals equipped with disk drives, file handling and graphical user interfacing. A browser **502** include instructions for accessing and displaying Internet pages, consulting HTML or WAP files and other item, that are usually present but inactive on the user's graphical display.
- 20 [0040] Duplication instructions **503** comprise the program steps required by the CPUs **301** and **401** to act upon objects, the type of which comprise either local objects **504** or duplicated objects **505**, also known as duplicas. Co-pending United Kingdom application number 00 26 095.0 of the present  
25 Assignee may be usefully consulted for reference to a more detailed description of duplicated objects and their functionality, which is not part of the present invention. In the preferred embodiment, instructions **503** enable

the terminal user to equip a local object **504** with attributes, generally as an input string by means of keyboard **205** or mouse **206** or a combination thereof. For instance, said input string may take the form of one or a plurality of keywords typed in by the respective users of user terminals **101**, **104**, **106** 5 and **108**, or machine-readable text derived from said terminal user activating mouse **206** of user terminal **101** or **104** or stylus **225** of user terminal **108**.

[0041] The actions performed by the duplication instructions **503** shown 10 in the user terminal's main memory in *Figure 5* when logging onto a network such as network **102** is detailed in *Figure 6*.

[0042] Upon activation of a user terminal at step **601**, the instructions 15 **503** necessary for the equipment of local objects with attributes and duplication and update thereof are loaded from an external medium, such as a CD-ROM or, in the case of a wireless internet-enabled mobile device such as cellular phone **106** and Palmtop PC **108**, downloaded from a network, at step **602**.

[0043] At step **603**, the terminal user equips an object with attributes, 20 such as an input string. For instance, the terminal user specifies criteria to be met by information sought regarding any particular geographical or topical point of interest. Upon completing the inputting action of step **603**, duplication instructions **503** perform a matching operation at step **604**, which compares the attributes of duplicated objects **505** stored in the main memory in order to 25 identify duplicates with fully or partially matching attributes. Said attributes of duplicated objects **505** are eventually matched and, at step **605**, duplication instructions **503** duplicate the publisher duplicated object onto the main

memory of the user terminal from which the matching subscriber duplicated object was initially issued. Data, which may or may not constitute the attributes of the publisher duplicated object is subsequently accessed by the duplication instructions **503** at step **606**.

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[0044] At step **607**, any amendments of the data and/or attributes of the publisher duplicated objects are forwarded by duplicated instructions **503** to every single replica of said publisher duplicated object currently stored by user terminals logged onto the network.

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[0045] A question is asked at step **608** which determines whether the terminal user wishes to equip another object with attributes, for instance to specify criteria to be met by information sought by said terminal user regarding a different particular geographical or topical point of interest. If the question asked at step **608** is answered positively, then control is directed back to step **603**, wherein the terminal user inputs a new input string in order for a match to be performed. If the question at step **608** is answered negatively, then the user terminal is eventually switched off at step **609**.

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[0046] Duplication instructions **503** define the duplication space, publisher objects and subscriber objects and their functionality, and are shown in *Figure 7*.

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[0047] A source file is shown in *Figure 7* which contains CPU instructions in ASCII characters, such as to be comprehensible by a computer programmer. Accordingly, said source file enunciates a program name **701**, programming language declarations **702** known to those skilled in

the art as 'header files' and a 'void main' declaration 703 which indicates that the declarations which follow constitute the main program.

5 [0048] According to the invention, the header files 702 identify the various objects required by the promotion program and which will be processed by duplication instructions 503 on each user terminal, the CPU of which executes the promotion program. The "Define" declaration 704 instantiates the duplication space known as 'promotion space', within which publisher duplicated objects generated by terminal users offering promotions and subscriber duplicated objects generated by clients seeking promotions will be matched. User-specified variables and methods are then defined in ASCII characters by the programmer in order to confer the logic steps known as algorithm, appropriate to the topic of the promotion program, to the program.

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15 [0049] The "Client::Create" declaration 705 instantiates the 'client' object as a duplicated object within the main memory of the client-subscriber terminal and the programmer accordingly specifies attributes such as variables and methods, or program steps, which will enable duplication instructions 503 to process the attributes of said client object as attributes of a subscriber duplicated object to whom matching publisher duplicated objects should be forwarded to. The "pClient → Publish" declaration 706 instantiates the 'client' object within the already instantiated duplication space known as 'promotion space' such that it can be duplicated on remote networked terminals and eventually matched with a relevant promotion.

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[0050] Similarly, the "Promotion::Create" declaration 707 instantiates the

'promotion' object as a duplicated object within the main memory of the client-publisher terminal and the programmer accordingly specifies attributes such as variables and methods, or program steps, which will enable duplication instructions 503 to process the attributes of said promotion object  
5 as attributes of a publisher duplicated object to whom matching subscriber duplicated objects should be forwarded to. The "pPromotion → Publish" declaration 708 instantiates the 'promotion' object within the already instantiated duplication space known as 'promotion space' such that it can be duplicated on remote networked terminals and eventually matched with a  
10 relevant client.

[0051] The above instructions represented in ASCII format will be familiar to those skilled in the art, particularly programmers skilled in C or C++ programming language. The duplication space created by instructions 704 and the subscriber objects and publisher objects respectively instantiated by  
15 programming instructions 705 to 708 are graphically represented in *Figure 8*.

[0052] The relationship between publishers of information and subscribers of information can be illustrated by a graph, with said subscribers ordained along the abscissa 801 and the publishers ordained along the  
20 ordinate 802, the duplication space being abstractly represented by the number of potential intersections between attributes of the subscriber objects, which are straight lines (803) parallel to the ordinate and perpendicular to the abscissa, and the attributes of the publisher objects, which are straight lines  
25 (804) parallel to the abscissa and perpendicular to the ordinate. The intersection of two of said respectively perpendicular lines 803, 804 identifies a match 805 between the attributes of a subscriber object and the attributes

of a publisher object. Thus, with reference to the potential number of subscribers and publishers present at any one time on large networks such as the Internet 102, the duplication space potentially comprise millions of publisher and subscriber objects, the comparison of the respective attributes of which is non-trivial.

[0053] In *Figure 8*, an arbitrary number of two sets of publishers P1, P2 are identified from amongst the totality of publishers Pm. Sets P1, P2 are subsets of the totality Pm of the publishers present within the duplication space, and are for instance based upon thematic criteria. Similarly, two sets of subscribers S1, S2 are identified from amongst the totality of subscribers Sn. Sets S1, S2 are subsets of the totality Sn of the subscribers present within the duplication space, and are for instance also based upon thematic criteria. Said sets define four cells C1, C2, C3 and C4 implemented in order to reduce the problem posed by a potentially infinite duplication space, in terms of computational resources required to process attributes comparison and obtaining an attribute match. Said problem and the solution according to the present invention are illustrated in *Figure 9*.

[0054] The totality of publishers Pm present within the duplication space can be expressed as the union of all the subsets P1, P2 etc. of publishers and thus as an expression 901:

$$Pm = P1 \cup P2 \cup \dots \cup Pm$$

Similarly, the totality of subscribers Sn present within the duplication space can be expressed as the union of all the subsets S1, S2 etc. of subscribers and thus as an expression 902:

$$S_n = S_1 \cup S_2 \cup \dots \cup S_n$$

As was previously explained, a cell can be understood as the range of potential attributes matching between the attributes of the publisher objects of a particular publisher set and the attributes of the subscriber object of a particular subscriber set. Thus, in the case of the publisher set P1 and the subscriber set S1, we arrive at the following formula 903 :

$$C_{1,1} = P_1 \cup S_1$$

Accordingly, cell C2 represents the range of potential attributes matching between the attributes of the publisher objects of publisher set P2 and the attributes of the subscriber objects of subscriber set S1 and so on and so forth. Thus, for any given set S1 of subscribers, its relationship with the publishers within the duplication space can be written as the expression 904 :

$$C_{1,m} = S_1 \cup P_m$$

and, reciprocally, for any given set P1 of subscribers, its relationship with the subscriber within the duplication space can be written as:

$$C_{n,1} = S_n \cup P_1$$

The relationship between the number of cells within the duplication space and the sets of publishers and subscribers can therefore be written as the expression 905 :

$$C_{n,m} = S_n \cup P_m$$

wherein a number ( $n \times m$ ) of cells are defined. Therefore, the implementation of the duplication space without cells would signify that one terminal connected to the network must process the attributes of every publisher and subscriber object within said duplication space with a processing load R placed upon it according to the expression 906:

$$R = C(P) \times C(S)$$

in order to perform the matching operation. By dividing the general duplication space according to better-defined criteria which are relevant to the domain of application of the program itself, and thus instantiating publisher and/or subscriber subsets, the comparison process required in order to obtain a situation of attributes matching is facilitated and the load R placed on the duplication instructions 503 of each user terminal connected to the network and controlling the duplicate master of a cell in order to perform said matching action is further reduced according to the general expression 907:

$$R = [C(S) \times C(P)] + (n \times m)$$

[0055] Referring back to *Figure 7*, wherein an example of program instructions written in the programming language C++ was provided, which instantiated a 'promotion space' which itself may now be understood as a cell within the duplication space, and instantiated subscriber client objects and publisher promotion objects, an additional programming declaration "DoCell" would need to be implemented between instructions 704 and 705 in order to further divide the cell known as 'promotion space' into more discrete cells. In the example, the 'promotion space' cell could be subdivided into four subsets, for instance a 'money' subset (corresponding to publishers offering promotions based on price and subscribers seeking out said price-based promotions), a 'quantity' subset (corresponding to publishers offering more goods or services for a specified amount of currency and subscribers seeking out said offers), an 'incentive' subset (corresponding to publishers offering gifts and other incentives to their customers and subscribers seeking such offers) and a 'competition' subset (corresponding to publishers running a prize draw to attract customers and subscribers seeking such offers).

[0056] For each of said subsets, we know that a publisher in 'promotion space' cell and 'money' subset can only match a subscriber also in 'promotion space' cell and 'money' subset and thus, the processing load expressed at 907 is further alleviated according to the expression 908:

$$C_{n,n} = S_n \cup P_n$$

wherein only a number n of cells are defined, and not (n x m) as previously.

[0057] The duplication space will be better understood when observing the initialisation of the main memory of each terminal logging onto the network according to steps 601 and 602, which is shown in *Figure 10*.

[0058] Upon user terminals 101 and 104 being switched on at step 601 and similarly, cellular telephone 106 also being switched on at step 601, the duplication instructions 503 are loaded into their respective main memories either by means of CD ROM drive 308 in the case of user terminals 101 and 104 or, downloaded from the network in the case of cellular telephone 106. Said loaded instructions include CPU instructions 701 to 707 which have been previously compiled into binary instructions, such that the respective CPU's of said user terminals and cellular telephone are able to process them. In the example, the entirety of the instructions loaded from said external medium forms an executable program, the primary function of which is to enable a terminal's user to either publish promotional offers and thus become a publisher within the duplication space, or access said promotional information, and thus become a subscriber within the duplication space. Accordingly, the first user terminal on the network to instantiate the cell known as 'promotion space' 704 in effect hosts the duplicate master 1001 of

the duplication space within the network. As said 'promotion space' **704** is defined by the duplication instructions **503**, and potentially further subdivided into a number of cells **902**, the duplication space object **1001** is permanent and thus always exists on the network, to the contrary of the publisher objects and subscriber objects which will be detailed further below.

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[0059] In the example, user terminal **101** is the first terminal to instantiate the promotion space and, as the 'promotion space' object stored in the main memory of user terminal **101** is the duplication master **1001** of said 'promotion space' object instantiated by each terminal connected to the network and executing the same instructions **503**, it thus updates the 'promotion space' instantiations **1002** and **1003** stored within the main memories of user terminal **104** and cellular telephone **106** respectively, which are known as duplicas. Co-pending United Kingdom patent application Number 00 26 095.0 of the present Assignee may be usefully consulted for reference to a more detailed description of duplicated objects and their functionality, which is not part of the present invention.

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[0060] The updating activity **1004** between the duplicate master **1001** of the 'promotion space' and the duplicas **1002** and **1003** of said promotion space is thus established and the duplication space object now exists and is shared by user terminals **101**, **104** and **106**.

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[0061] Referring back to *Figure 6*, terminal users equip objects with attributes by means of an input string at step **603**. Depending upon the class **706**, **707** of objects selected by the terminal user for attributes equipping, said object is either a publisher object or a subscriber object. In the example,

the user of network terminal 104 is a stock exchange trader and selects a promotion object 707 in order to equip it with a "two-for-one share offer" promotion. Upon completing the equipping of the promotion object 707 with attributes pertaining to said "two-for-one share offer", a publisher object 1005  
5 is created at user terminal 104 and subsequently stored as a local object 505 in its main memory.

[0062] The user of user terminal 106, which is a cellular telephone, is also a stock exchange trader and is on the lookout for such share-based promotional offers. Consequently, said user selects a client object 706 and equips it with attributes pertaining to the identification of promotion "two-for-one share offer promotions" by means of an input string entered on keypad 214 according to step 603. Upon completing the object attributes inputting operation 603, a subscriber object 1006 is thus created at user terminal 106  
10 and stored as a local object 505 in its main memory. According to the invention, publisher objects and subscriber objects are matched within the duplication space according to their attributes at step 604, which is further  
15 detailed in *Figure 11*.

[0063] Upon instantiating either a publisher object or a subscriber object equipped with attributes, the duplication instructions 503 access said attributes in the new local object 505 at step 1101 in order to answer a question asked at step 1102 which determines whether said attributes of the new local object match the cell attributes. In the example, attributes of the  
20 "two-for-one share offer" publisher object 1005 are processed to determine whether said object belongs to the 'promotion space' object 1003. If the question asked at step 1102 is answered negatively, then control is returned  
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to step 1101 and duplication instructions 503 access attributes in another local object 505 until such time as question 1102 is answered positively.

5 [0064] When the question asked at step 1102 is answered positively, duplication instructions 503 send a replica of object 505 to the host of the duplicate master of the cell at step 1103. At step 1104, said host of the duplicate master of the cell receives the replica of the publisher object or subscriber object and selects the next duplicated object 504 stored in its main memory. Upon completing said selection step, the duplication instructions 10 503 of the host access attributes within the selected duplicated object at step 1105 in order to compare them with the attributes of the replica received at step 1103, at step 1106.

15 [0065] At step 1107, a question is asked as to whether the attributes of the replica received and the attributes of the replica selected at step 1104 respectively match. In effect, duplication instructions 503 establish whether the input string or, potentially, executable instructions which form part of the attributes of the duplicated object, which say is a publisher object, are present within the input string or potentially, executable instructions which 20 form part of the attributes of another duplicated object which say is a subscriber object. Thus, if the question asked at step 1107 is answered in the negative, control is returned to step 1104 wherein duplication instructions 503 select the next duplicated object 504 present in the main memory in order to perform another comparison, such that the question asked at step 1106 is 25 eventually answered in the positive.

[0066] A graphical representation of the duplicated objects as shown in *Figure 10* subsequently to the actions detailed in *Figure 11* is provided in *Figure 12*.

- 5 [0067] The attributes of the "two-for-one share offer" publisher object 1005 are identified (1203) as matching the attributes of the 'promotion space' cell duplica 1002 and thus the "two-for-one share offer" publisher object 1005 is duplicated by the duplication instructions 503 stored in the main memory of user terminal 104 at user terminal 101, the main memory of which stores the 10 duplicate master 1001 of the 'promotion space'. Consequently, a publisher object duplica 1201 is instantiated in the main memory of user terminal 101 as a duplicated object 504.
- 15 [0068] Likewise, the attributes of the "two-for-one share offer request" subscriber object 1006 are identified (1204) as matching the attributes of the 'promotion space' cell duplica 1003 and thus the "two-for-one share offer request" subscriber object 1006 is duplicated by the duplication instructions 503 stored in the main memory of user terminal 106 at user terminal 101, the main memory of which stores the duplicate master 1001 of the 'promotion 20 space'. Consequently, a subscriber object duplica 1202 is instantiated in the main memory of user terminal 101 as a duplicated object 504. Both of duplicated objects 1201 and 1202 are respectively updated by their duplicate master 1005 and 1006, such that any changes implemented locally at user terminal 104 or user terminal 106 respectively, to the attributes of the objects 25 which are duplicate masters are instantly propagated to their duplicas stored in user terminal 101.

5 [0069] Referring back to *Figure 6*, upon completing the attribute matching operation of step 604, the duplication instructions 503 stored in the host of the duplicate master of the cell subsequently duplicate the matching object at step 605, further details of which are shown in *Figure 13*.

10 [0070] Upon answering the question asked at step 1105 positively, duplication instructions 503 stored in the main memory of the user terminal which stores the duplicate master 1001 of the cell identify the publisher of the publisher object dupica 1201 at step 1301. Once identified, said publisher is updated with the identification and details of the matching subscriber at step 1302. In effect, the duplication instructions 503 stored in the main memory of the host of the cell duplicate master, of the duplicate space send a string to the duplication instructions 503 of the host of the duplicate master of the publisher object with the network address of the host of the duplicate master of the matching subscriber object.

15 [0071] At step 1303, the duplication instructions 503 stored in the main memory of the host of the duplicate master of the publisher object, add the matching subscriber to the list of current recipients of duplicas of the publisher object which require update from its duplicate master. Further to carrying out the updating operation of step 1302 and whilst the host of the duplicate master of the publisher object carries out the updating operation of step 1303, the host of the duplicate master of the cell duplicates the publisher dupica 504 at the host of the duplicate master of the matching subscriber object at step 1304. A graphical representation of the duplicated objects shown in *Figure 12* subsequently to the actions shown in *Figure 13* is

provided in *Figure 14*.

[0072] As user terminal 101 stores the cell duplicate master 1001 and therefore receives the duplicate 1201 of the "two-for-one share offer" publisher object 1005 from user terminal 104 and the duplicate 1202 of the "two-for-one share offer request" subscriber object 1006 from user terminal 106, the duplication instructions 503 stored in user terminal 101 subsequently 5 match (1401) the "two-for-one share offer" portion of the respective attributes of duplicates 1201 and 1202. Consequently, said duplication instructions 503 identify user terminal 104 as the publisher of publisher object dupica 1201 10 according to step 1301 and update (1402) the duplication instructions 503 stored in user terminal 104 with the identification and details of user terminal 106, as said user terminal 106 stores the duplicate master 1006 of the matching subscriber object 1202. Duplication instructions 503 subsequently 15 duplicate (1403) publisher object 1201 at user terminal 106, which thus instantiates a "two-for-one share offer" publisher object 1404 in its main memory.

[0073] In effect, upon equipping a client object 706 with attributes and 20 thus initialising a subscriber object 1006 by means of keypad 214, the user of user terminal 106 has generated a search request with a specific criteria, with said criteria being the attribute of its subscriber object and subsequently receives a search result 1404 which is processed by local duplication 25 instructions 503 and graphically displayed on visual display unit 213 by means of browser 502. As publisher object 1404, stored in the main memory of user terminal 106 is a duplicate of publisher object 1005, and user terminal 104 which stores the duplicate master of publisher object 1005 has been

updated with details about the host of matching subscriber object duplica 1202, said duplication master 1005 is now in a position to update duplica 1404 stored in user terminal 106. Details of the update of the duplicate by their respective duplicate master, as according to step 607, are further 5 detailed in *Figure 15*.

[0074] Upon updating the list of duplica recipients according to the string received from the host of the duplicate master of the cell as according to step 1303, the user terminal which stores the duplicate master of the publisher 10 objects answers a question asked at step 1501 which determines whether the attributes of a local object 505 have been modified. If the question asked at step 1501 is answered in the positive, then duplication instructions 503 stored in said user terminal which stores the duplicate master subsequently updates all of the duplicas relating to said duplicate master with the attribute 15 modifications at step 1502. In order for the user terminal which stores the duplicate master of the cell to more accurately perform the matching operation of step 604, said duplicate master of publication object also updates its duplica stored on said terminal at step 1503.

[0075] Alternatively, if the question asked at step 1501 is answered 20 negatively, then the process is directed to the following step 1504, wherein a question is asked in order to determine whether the keep-alive signal perpetuated between a duplicate master and its respective duplicas has returned a failure status or not. If the question asked at step 1504 is 25 answered in the positive, which then can be translated as the terminal the main memory of which hosts the duplicate master has logged-off the network or shutdown, then at step 1505 the duplication instructions 503 of every user

terminal on the network which stores a dupica of the now defunct duplication master execute a poll operation in order to identify the 'cell' dupica most able to take on the role of 'cell' duplicate master and, subsequently, switch the state of the identified 'cell' dupica to the state of 'cell' duplicate master at step 5 **1506.**

[0076] Alternatively, if the question asked at step **1504** is answered negatively, then the process is directed to the next step **608**, wherein duplication instructions **503** determine whether another object requires equipping with attributes or updating, and the user terminal is eventually switched off as at step **609**. A graphical representation of the duplicated objects shown in *Figure 14* subsequently to the actions shown in *Figure 15* is provided in *Figure 16*.

[0077] It is established that duplication master **1005** stored in user terminal **104** is in a position to update dupica **1404** stored in user terminal **106** according to steps **1501** through to **1503**, upon completing steps **603** through to **605**. Thus, the "two-for-one share offer" publisher object **1001** provides "two-for-one share offer" duplicas **1201** and **1404** respectively stored in user terminals **101** and **106** with respective updates **1601**, **1602**, should any change be implemented to the attributes of said "two-for-one share offer" publisher object by the user of user terminal **104**. Similarly, any changes implemented to the attributes of the 'promotion space' object **1001** would be implemented on the duplicas **1003** and **1005** by means of update actions **1603** and **1604** respectively. Finally, any changes implemented to the attributes of "two-for-one share offer" request subscriber object **1006** would be implemented to the attributes of its respective duplica **1202** by means of

update 1605.

[0078] In the example, it can be observed that user terminal 108 has been switched on, logged onto the network and loaded instructions including duplication instructions 503 which themselves include executable instructions 701 through to 707. Consequently, the graphical representation of the main memory of user terminal 108 shows a duplica 1604 of the 'promotion space' 704, the attributes of which are updated by 'promotion space' duplicate master 1001. In the example shown, the user of network terminal 108 is a financial editor who seeks information about what specific types of promotions stock market traders are interested in. Accordingly, a subscriber object 1605 is shown in the graphical representation of the main memory of user terminal 108, which includes attributes inputted for this purpose, and said objects may thus be known as a "type of share promotion" subscriber object. The matching of the attributes of subscriber object 1605 and sharing thereof according to the invention are illustrated in *Figure 17*.

[0079] According to the invention, upon completing the equipping of the "type of share promotion" subscriber object with appropriate input string or executable instructions and matching said attributes with the attributes of the 'promotion space' duplica 1604, said "type of share promotion" subscriber object 1605 is duplicated (1701) at user terminal 101. Consequently, a subscriber object duplica 1702 is instantiated in the main memory of user terminal 101 as a duplicated object 504. As user terminal 101 already stores the duplica 1201 of the "two-for-one share offer" request subscriber object 1006, stored in user terminal 106, the duplication instructions 503 stored in user terminal 101 subsequently match (1703) the "share offer request"

portion of the respective attributes of duplicate **1201** and **1702**. In a preferred embodiment of the present invention, the matching of the attributes of a new subscriber object with the attributes of an already-existing subscriber object switch the state of said existing subscriber object to that of a publisher object.

5        Accordingly, duplication instructions **503** identify user terminal **106** as the publisher of publisher object duplicate **1202** according to step **1301** and thus updates **(1704)** the duplication instructions **503**, stored in user terminal **106**, with the identification and details of user terminal **108** as said user terminal **108**, stores the duplicate master **1605** of the matching subscriber object **1702**. Duplication instructions **503** subsequently duplicate **(1705)** publisher object **1202** at user terminal **108**, which thus instantiates a "two-for-one share offer request" publisher object **1706** in its main memory.

10      [0080] According to the invention, duplicate master **1006** eventually updates **(1707)** duplica **1706** of the "two-for-one share offer request" publisher object stored in user terminal **106**.

15      [0081] It can be observed that user terminal **104** is not present on the network anymore. As said user terminal **104** stored a duplica of the promotion space **1001**, the failure of its keep-alive signal is of no significance. However, the failure of the keep-alive signal of the duplication master **1005** which was stored therein has prompted duplication instructions **503** respectively stored in user terminal **101** and **106** to discard duplicas **1201** and **1404** respectively, as publisher object and subscriber object are not configured to be persistent on the network.

[0082] Therefore, according to the present invention, there is provided an apparatus for sharing data over a network within which the accuracy of the matching operation performed in order to relate information publishing and subscribing is vastly improved over the prior art. Indeed, search results returned by the duplication instructions of the user terminal which stores the duplicate master of the duplication space only ever include information published at the time or near the time of a search and thus do not include information which is potentially years or months old. Similarly, as the duplication space can be instantiated with geographical, topical or logical restrictions, expressed as attributes, the potentially millions of redundant search results generated on the basis of a Boolean parameter-driven search are avoided, as the search is conducted within a volume of information already delimited as relevant and identified.